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REPORT FOR THE CALENDAR YEAR 1935
OF THE
PACIFIC NORTHWEST FOREST EXPERIMENT STATION

The United States Court House. Offices of the Station are on the Fourth Floor.

Contents

	Page
Introduction	1
Personnel, Finances, Quarters, Equipment, Library	3
Experimental Forests	7
Silvicultural Studies	
Forestation and Botanical Research	8
Douglas Fir Silviculture	9
Ponderosa Pine Silviculture	11
Fire Studies	13
Forest Mensuration	15
Forest Survey	17
Forest Land Economics	22
Logging Economics	25
Forest Products Investigations	27
Publications	32
Appendix - List of Current Projects	36

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Reports
Annual

Portland, Oregon
January 23, 1936

REPORT FOR THE CALENDAR YEAR 1935 OF THE PACIFIC NORTHWEST FOREST EXPERIMENT STATION

Introduction

The year 1935 has been characterized by an acceleration of progress in the research program, by the most active field season in the history of the Station, by the issuance of significant results of a number of projects and by much physical development on the experimental forests. Emergency funds have made possible increased activity. In spite of the uncertainty as to the amount or duration of these special allotments the orderly long-time program of research has been adhered to. Selecting, training, and supervising a very considerable number of new employees engaged for a temporary and uncertain period has put a double burden upon the regular personnel, that has been carried most creditably.

Had the marked expansion of the research allotment anticipated under the Emergency Relief Appropriation materialized, work could have been begun in certain fields heretofore untouched by this Station, such as Forest Range Management, Relation of Forest and Range Management to Water Supplies and Soil Conservation, Relationships of Forest Management to Society, etc. However, the ERA allotment as received provided for the employment of those on relief rolls, most of whom could be used only on non-technical routine and manual work.

A meeting of the Regional Investigative Committee in April passed upon the program of studies to be made; for sundry reasons no meeting of the Forest Research Council was held in 1935.

Even more than heretofore the Station's research program has been tied in with the work of other bureaus of the Department of Agriculture and of other Departments. With the local offices of Forest Entomology under F. P. Keen and of Forest Pathology under J. L. Bedwell particularly, there has been intimate cooperation on certain projects. Much of the Station's activity is naturally on the national forests, to which local forest officers contribute and cooperate materially. No attempt is made in this condensed report to cover the "administrative studies" of national forest officers, even though allied to the Experiment Station's work, nor those research studies allocated to Regional Forester C. J. Buck's staff, such as those in the field of artificial forestation.

Personnel

The Station suffered during the year the loss of four of its experienced and valued personnel, namely, Edith A. Parmeter by resignation, C. Weldon Kline by transfer to the Regional Forester's Office, Elmer F. Rapraeger by transfer to the Northern Rocky Mountain Forest Experiment Station, and Dr. Walter H. Meyer by resignation January 1, 1936, to become Professor of Forest Management at the University of Washington.

The regular personnel now consists of the following:

Thornton T. Munger	Director
Horace J. Andrews	Senior Forest Economist
Axel J. F. Brandstrom	Senior Forest Economist
Sinclair A. Wilson	Senior Forest Economist
John E. Lodewick	Senior Silviculturist
Robert W. Cowlin	Asst. Regional Director, Forest Survey
Percy N. Pratt	Timber Expert
Herman M. Johnson	Associate Forester
Donald N. Matthews	Associate Silviculturist
Paul D. Kemp	Associate Forest Economist
Leo A. Isaac	Associate Silviculturist
Floyd L. Moravets	Associate Forester
Philip A. Briegleb	Associate Forester
Ernest L. Kolbe	Assistant Silviculturist
William G. Morris	Assistant Silviculturist
Warren H. Bolles	Assistant Forester
Edward D. Buell	Assistant Forester
June H. Wertz	Principal Clerk
Christina M. McPhail	Clerk-Stenographer
Frances Elliott	Clerk-Stenographer
Inga Frisvall	Clerk
Edna M. Hunt	Assistant Clerk-Stenographer
June E. Suckow	Junior Clerk-Stenographer
Elizabeth Straw	Under Clerk-Typist

In connection with reorganizing and reclassifying the personnel of the Forest Service, many of the regular positions at this Station have been regraded, with consequent advancements in salary of the incumbents.

On December 31 twenty-nine temporary employees paid from emergency funds were on the rolls, of whom all but six were technically trained men (or practical cruisers). Altogether the following temporary employees were under appointment during the calendar year, of whom sixteen are on the rolls now.

William Beeman	Jr. Forester	George S. Meagher	Jr. Forester
Roy C. Carlson	" "	Marion Nance	" "
Earl G. Dunford***	" "	Walter Pelto	" "
Stanton B. Hayward	" "	Boyd L. Rasmussen	" "
Arthur W. Hodgman	" "	Clarence Richen	" "
LeRoy Huntington**	Asst. Technician	William E. Sankela	Asst. Forester
David Judkins	Jr. Forester	Emily Sullivan	Under Clerk-Typist
Richard S. Kearns**	Asst. Forester	Reese W. Taylor*	Asst. Forester
Morten J. Lauridsen**	Asst. Technician	Frederick Vogel***	Asst. Technician
Wickliffe Litchfield	Asst. Forester	Charles H. Willison	Jr. Forester
Francis McCabe	Jr. Forester	Harry M. Wolfe	" "

*Transferred **Resigned ***Furloughed

In addition a considerable number of persons have been temporarily employed on the emergency rolls during a part or all of the year. At this time there are thirteen such employees, as follows:

Marion Becquet	Under Clerk	Lawrence Frost	Asst. Technician
George Byram	Asst. Technician	George Jackson	" "
Merritt Corbin	" "	Erna Jeppesen	Junior Clerk
Wm. Detering	Eng. Draftsman	Don J. Shellhart	Under Clerk
Grace Frederickson	Asst. Clerk	Cecil Smith	Asst. Technician
George Frost	Asst. Technician	Lawrence Tucker	" "
		Everett Vose	" "

Under the Emergency Relief Appropriation this Station has an allocation of 76 man-years of "relief rollers" and nine "ten percenters", commencing July 10, and under this as many as 103 people have been employed at one time, partly in the office for map work and computing and partly for manual labor on the experimental forests. Also, the Station has used a squad of CCC boys at each of the experimental forests for improvement and construction work.

Finances

Since allotment of funds is made for a fiscal year beginning July 1, a statement of the financial set-up for the calendar year cannot be made precisely. The regular appropriation for the Fiscal Year 1936 (commencing July 1, 1935) was $97,950, divided as follows: Forest Survey $44,000, Forest Management $26,650, Forest Products $14,300, Forest Economics $13,000. This is the same (except for a technical adjustment) as for the preceding year and some $69,350 less than for the F.Y. 1932.

Emergency appropriations seemingly offset this decrease, but being uncertain and temporary could by no means be used in the same way in carrying out a stable, long-time, technical program.

The Emergency Conservation Work allotment has varied from $7,464 to $6,250 per month, approximately two thirds of which was designated for the Forest Survey. The allotment under the Emergency Relief Appropriation (beginning July 1935) was at the average rate of $1,026 per man-year for the 85 places authorized, including technical supervision, supplies, transportation, etc.

Quarters

The Station has continued to occupy its very satisfactory suite of 28 rooms on the fourth floor of the U. S. Court House, with overflow during the winter into two large rooms on the seventh floor. In the housing and overhauling of its automobiles the facilities of the Forest Service's new warehouse in Portland are used.

Equipment

No major pieces of new equipment (other than 5 autos) have been added during the year. Replacements and additions commensurate with the increase in personnel have been made, bringing the value of all field, office, and laboratory equipment, including 24 passenger automobiles and trucks, up to $30,720, according to the June 30, 1935 inventory.

Library

Late in 1934 a trained librarian was employed from emergency funds and devotes a considerable portion of her time to the maintenance of the library, something that was not possible heretofore. The library material has been reclassified according to the Society of American Foresters' system, the one now used by the Forest Service library. Reference cards have been made for significant articles in the magazines and technical journals, and this service may be extended to include complete indexing of lumber journals. This increased attention to the library, which is maintained as an auxilliary of the library in the Regional Forester's office in the Main Post Office Building, has materially augmented its use and usefulness within the Station and to the outside public. The library committee has sought to build up the collection by acquiring publications of special value to the staff members in the various fields of research. During the year 48 books and 732 pamphlets and reprints have been added, as well as many manuscripts.

The photograph collection is now being reclassified and cross-referenced by the same system that applies to the manuscripts and pamphlets.

Experimental Forests

The Blue Mountain Experimental Forest of 11,471 acres, on the Whitman National Forest, was established by the Chief of the Forest Service. This increases the number of such research centers to four - this and Pringle Falls representative of different regional phases of the ponderosa pine type, Wind River characteristic of the Cascade Douglas fir region, and Cascade Head of the spruce-hemlock type of the northern Oregon Coast Range. A considerable amount of development work has been done on all these areas with CCC or ERA labor. Much of the work has been capital investments in roads to facilitate harvesting the forest crop by experimental methods, in trails to aid administration and protection, in stand improvement experiments and other research plots and in constructing headquarters facilities. Some of the principal accomplishments are as follows:

At Blue Mountain Experimental Forest

Completing field work of an intensive survey and description.
Placing portable buildings, telephone connection, and fencing.
Building or improving, and roadside cleanup, on 3 miles of road.

At Cascade Head Experimental Forest

Establishing 16 permanent growth study plots.
Work done on 5 miles of new road and several more miles located.
Eight miles of trail built.
Two portable camps for 25 men each built.
Office work on type maps and estimates completed.

At Pringle Falls Experimental Forest

Deep well water system installed at headquarters.
A three-room residence built and other buildings remodeled.
An experimental plantation made and fenced.
Fire protection cleanup along 4 miles of road.
Experimental burning down of snags.
Establishing primary elevation bench marks.
Office work on type maps and estimates completed.

At Wind River Experimental Forest

Four miles of new log transport road worked on, some finished.
Six miles of administrative trail built.
The old "office" built in 1911 moved to new location.
Warehouse-garage finished and new office begun.
Eight acres of stand improvement plots made in a decadent forest.
Maintenance work conducted on arboretum, thinning plots, etc.
Hazard reduction cleanup along 10 miles of road.

A suitable area for an experimental forest typical of the Port Orford cedar and Douglas fir types of southwestern Oregon has been found, cruised, and a report prepared recommending its establishment.

A part of the Pringle Falls Experimental Forest, covering 1,160 acres of virgin ponderosa pine and of lodgepole pine forest, was set aside as a natural area. This is the sixth area in this Region to be so withdrawn for preservation in its natural condition.

Silvicultural Studies

Forestation and Botanical Research

The six plantations of regional races of ponderosa pine that received their sixth year measurement during 1935 brought out the importance of the source of seed in planting. Growth of seedlings from seed secured from certain localities made double the growth of those from other parts of the range of the species.

The 10-year measurement of the Douglas fir spacing test plantation showed crowns practically closed on the 4 x 4 and 5 x 5 spacing and the highly inflammable herbaceous vegetation completely crowded out, with the vegetation proportionally reduced on the 6 x 6, 8 x 8, and 10 x 10 plantations. Natural stands having an equal number of trees were

not as successful in reducing native vegetation because of their uneven spacing.

Ten lots of cuttings of fast-growing hybrid poplars were received from the Oxford Paper Company and tested out at the Wind River nursery. They will be outplanted at the Cascade Head Experimental Forest in the spring. These hybrids were developed in cooperation with the New York Botanical Garden and some are reputed to be showing several times the growth rate of native species.

Phenological observations are now being taken at one or more points on all national forests, at Portland, at the Pack Demonstration Forest of the University of Washington, and the McDonald Forest at Oregon State College. Requests for the findings are coming from a wide range of sources, such as pole companies wanting to know the dates that bark begins to slip and to stick in a certain locality; beekeepers requesting the dates of fireweed flowering on the Tillamook Burn; investigators outside this region seeking strains of plants that pollenate at an earlier or later date than their own.

In connection with seed crop observations, reports have been furnished to forest schools, collectors, and other interested agencies. Eleven new lots of conifers have been outplanted at the Wind River Arboretum and seed obtained for a few species still lacking in our collection. Foreign seed exchanges this year show contacts with seven nations.

Douglas Fir Silviculture

Studies in Douglas fir silviculture were, until 1935, confined primarily to areas clear cut and broadcast burned. These studies showed that the life of seed in the soil was short, probably not more

than a year; that three fourths of the single seed trees left were either dead or down by 10 years after logging and they were not very effective in reseeding; that effective seed dissemination extended for 1,000 to 1,500 feet from green timber but was exceedingly variable; that various environmental factors such as drought, heat injury, and frost injury took a heavy annual toll of seedlings on cut-over lands, averaging over 80 percent during the first year; that slash burning made site conditions more severe.

During the past season the data on environmental factors and on the influence of slash burning were worked up in manuscript form for publication.

With the trend toward "selective" cutting through the use of trucks and tractors in logging, studies in Douglas fir silviculture have largely shifted during the year from clear-cut areas to partially-cut areas. A crew was put in the field to study the silvical results of "selective" logging on areas that had received some form of partial cutting within the last few years. These studies, while still in their preliminary stages, show that windfall is a serious factor particularly in the spruce-hemlock forest, and that mechanical injury and fire hazard have to be reckoned with. The growth of the reserve stand was investigated and also the effect of various forms of selection on the subsequent development of the stand and particularly on the species composition. The study brought out that in many instances on private land where sound, high-value material only was removed and defective living trees were not cut, the reserve stand was highly decadent and in a silvically undesirable condition.

A survey was made of the natural regeneration on the great Tillamook Burn, both to determine principles of seed dissemination and seedling establishment and to acquire knowledge as to the present forest cover on this important area. Two years after the fire approximately three fifths of this 275,000-acre area has medium or full restocking. The study indicated that where the fire was not extremely hot, cones remained on the fire-killed trees and shed their seed on the ashes, thus accounting for the abundance of natural regeneration the first year following the fire. In the face of practically certain destruction by salvage operations and future fires in this almost endless snag patch a new forest is starting.

Ponderosa Pine Silviculture

The management of ponderosa pine timberlands is complicated by the prevalence of overmature decadent trees, shortage of thrifty growing trees, and susceptibility to bark beetle ravages. The studies of silviculture in the pine region are directed to determining the cultural treatment or cutting that will best bring about a healthy forest having a high rate of growth and full production. The several phases of the problem are carried on in a varying degree of intensity on test areas in four widely separated localities, all in central and eastern Oregon. Last season four new plots were cut over under different methods and records were taken that will permit a measure of the effects from time to time. The 278 acres of older plots are now beginning to yield valuable data on silvicultural practice, which are being used by foresters and others.

The ponderosa pine forest is exposed to extremes of drought, heat and cold, all of which in excess are antagonistic to the best forest development. While the climate cannot be changed, the local environmental factors of the surface and soil can be altered by variation in cutting methods, slash disposal, etc. The shading afforded by trees, shrubs and vegetation, as well as the amount of debris and duff on the surface, are factors to be considered in timber growing. In 1935 a beginning was made in a study of physical factors at the Pringle Falls Experimental Forest in central Oregon to determine what the environmental factors really were and how the plants reacted to the various conditions. For example, a tract was cleared of all vegetation and debris, and temperatures, moisture and evaporation conditions recorded and compared with those taken on untreated areas. The results were striking, especially in respect to the surface temperatures. The shade of trees and shrubs, and as little as one-half inch of needle litter, were found to have a marked influence on the temperatures and soil moisture conditions of the top soil layer. During the period of the test at Pringle Falls, air temperatures did not change the soil temperatures below the one-foot mark on several situations. These soil temperatures remained constant even though for a period the surface had a temperature of over 80 degrees higher. This preliminary study of physical factors in the pine type has given a better understanding of growth conditions and valuable data wherewith to check the results obtained on the intensive study plots.

On a two-acre tract within the Pringle Falls Experimental Forest an experimental attempt was made by cutting to convert a form of

worthless lodgepole pine forest into a ponderosa pine stand. This borderland type between ponderosa pine and lodgepole pine has an overwood of lodgepole pine with an abundant stand of ponderosa pine saplings beneath. In the treated area there were over 3,000 such saplings per acre, and though they were 50 years and over in age, very few exceeded 5 feet in height.

Fire Studies

The challenging new problems confronting all fire protection agencies, resulting from the increase in partial cutting as a logging practice in the Douglas fir region, were made the subject of the only new project initiated during the year. The first step was to find some means of appraising the increase in hazard resulting from different degrees of partial cutting, because this is a matter about which there is much controversy. A method of sampling cover and fuel conditions, so as to get the data needed in making appraisals of hazard, was worked out, based on the examination of small plots taken at arbitrary intervals. Shade (crown density), brush, ground cover, kind and amount of fine material on the ground surface for fire to run in, probable rate of spread, and the difficulty of control are some of the factors estimated plot by plot so that average conditions can be determined and comparisons made. A new method, using a photoelectric light meter, was developed to get comparable measurements of density of crowns (light conditions).

This new technic of measuring fuels by the plot method was widely used during the field season in studying fire hazard problems

of partial cutting and clear cutting in Douglas fir, and also used in studying the behavior and control of going fires. In all, several hundred tracts were examined and thousands of individual fuel plot records were secured for analysis. For example, on one tract appraised by this method before and after cutting, the tractor logging of 30 percent of the stand increased the probable rate of spread 63 percent, increased the difficulty of control 23 percent, and increased the length of the fire season.

The studies of the effect of visibility conditions on lookout performance that have been under way for several years continued to bear fruit in 1935. Several articles appeared in scientific journals describing the results obtained, and another was nearly completed, entitled "Visibility Factors Controlling the Efficient Location and Operation of Forest Fire Lookout Stations". One hundred of the haze meters invented by George Byram have been built at the Station and furnished to the lookouts of Region Six. Administrative officers are enthusiastic over these meters because they are now able to obtain from their lookouts strictly comparable measurements of visibility upon which to base action to meet changing conditions. The 150 fire-danger stations with their low-cost equipment--rain gauge, wind vane, wind gauge, fan psychrometer and hazard indicator sticks and scales--continue to grow in favor, and the servicing of them is an important activity of the Station.

Continuing the study of going fires, Matthews and Morris spent several days on a 1,700-acre fire, where the average per man

performance of the 1,100 fire fighters as affected by the difficulty of line construction was recorded in detail. This is the first comprehensive time study of fire fighting made in this region.

Cut-over lands of different ages in practically every county in the Douglas fir region of Oregon and Washington were explored during the summer to add to the existing large mass of information now available for a report on slash disposal after clear-cut Douglas fir logging.

For a permanent historical record a compilation of all available authentic material on the origin, behavior, and effects of the Tillamook Fire of 1933 was assembled and arranged.

As one current phase of Morris' lightning storm investigations, Robert A. Ward made a study of the synoptic weather maps of the past ten years and determined the types of days that produce the widespread lightning storms which sometimes cause as many as 200 forest fires in a single day in Washington and Oregon.

Forest Mensuration

The Section of Forest Measurements has been successful during the past year in bringing to fruition several important investigations. Especially notable is the yield study of even-aged stands of the Sitka spruce-western hemlock type, data for which were gathered throughout the type's range, in Oregon and Washington by the Station's field party, in Alaska through cooperation of the Regional Forester there, and in British Columbia through the courtesy of the local forest officials. A U.S.D.A. Technical Bulletin on this study has been

written and edited. One of the interesting facts brought to light through this study is that the spruce-hemlock type is capable of producing a substantially greater volume than Douglas fir on a comparable site. Characteristics of this type that are brought out by the results of this study include early production of clear, high-quality hemlock lumber, ease and rapidity of regeneration, fast growth, and capacity to produce tremendous volumes of pulpwood in a short rotation and as thinnings.

Coordinate with the silvicultural studies of partially cut stands in the Douglas fir region, necessitated by the increase in tractor-truck logging, a beginning has been made in the study of the growth of such stands, particularly in the spruce-hemlock type.

The growth phase of the Forest Survey for western Oregon and western Washington was practically completed during the year. In the report on this work, now nearly complete, reliable information will be given as to the actual growth of all the forest types west of the Cascade Range. The estimates made in this report are based on tens of thousands of growth calculations. They cover (1) current annual growth, (2) potential annual growth, and (3) realizable mean annual growth from the present time to the time when cutting will take place if depletion continues at the present rate. Growth estimates are made in terms of cubic feet and board feet by Scribner rule, both under present utilization methods and more intensive methods.

Standard volume tables for Sitka spruce and for silver fir were added during the year to the series of volume tables on which the

section has been at work for some years. Each set of tables is based on a large number of individual tree measurements compiled by a standard, proven technic. They give volumes in cubic feet, in board feet International rule, and in board feet by Scribner rule for several different degrees of utilization.

Ten separate reports were completed on recent measurements of 49 permanent sample plots in stands of the spruce-hemlock, Douglas fir, and ponderosa pine types. Availability of these measurements makes possible valuable comparisons between actual growth and yield and the growth and yield shown by normal yield tables. Sixteen permanent sample plots were newly established in the spring in spruce-hemlock stands on the Cascade Head Experimental Forest near Otis, Oregon. These form the nucleus of plot series to be used for studies of growth and yield, and stand-improvement methods in that important timber type.

Office work was brought close to completion on the range-wide study of the yield of even-aged stands of ponderosa pine, which will result in a technical bulletin. Data for this study were gathered from the pine regions of California, South Dakota, Montana, Idaho, Oregon, and Washington.

Forest Survey

The Forest Survey of Oregon and Washington was in an advance stage by January 1, 1935. Field work in the Douglas fir region had been completed for some time, inventory phase statistics had been

published, 1-inch-to-the-mile county type maps had been made and widely distributed. Basic computations for the depletion and growth phases were practically completed. The Douglas fir regional report had been commenced and one or two of the eleven unit reports. In the ponderosa pine region field work had been completed for the east slope of the Cascades in Oregon and for a relatively small area in north central Washington, while east side inventory compilations had just been started.

During the early part of the current year work on the Douglas fir unit reports and east side inventory phase office work was carried on simultaneously. By July, when the last of the crew left for the field, the rough drafts of the Douglas fir unit reports were completed and substantial progress on east side inventory phase computations had been made. The saw-timber volume data for the Douglas fir region were analyzed and separated into "availability classes". A digest of this material was prepared by Kline and published in The Timberman. This information has been used widely and many requests have been received for reprints of this article. Early in the year the instructions for east side field procedure were thoroughly revised.

Several temporarily employed type mappers started field work early in the spring, and by May there were 17 men in the woods. Some of these had to be dropped July 1 due to the reduction in ECW funds, but the loss of these was compensated by the regular Survey personnel going into the field, and from July 1 until late in the fall

there were 19 men in the field - 17 type mappers and 2 check cruisers. Cruising and type mapping continued until late in November for most of this group, and several worked in December, with 2 men still in the field at the end of the year. The objective was attained of completing all field work in the State of Washington and enough in Oregon to finish the state type map for the southeast quarter. Adjustment cruising was completed for both States. During the summer survey crews worked in some of the most inaccessible territory in the two States, and there were a number of long camp trips with pack horse strings. In June, airplane pictures of over 1,000,000 acres in the Wallowa Mountains were taken.

The depletion and growth phases of the Douglas fir region were completed early in 1935. Data on depletion from cutting, fire, and other causes were correlated and memorandum reports written. These data were analyzed and future depletion rates assumed. Future depletion and growth were estimated and correlated for the next three decades and the inventory figures projected into the future for thirty years.

At the beginning of the year 1-inch-to-the-mile detailed type maps had been prepared and widely distributed for all of the Douglas fir region, but none had been prepared for eastern Oregon and eastern Washington. During 1935 such maps were prepared for thirteen counties in eastern Oregon and Washington.

Early in the year the $\frac{1}{4}$-inch-to-the-mile base maps for the east halves of both States were received from the lithographer and

were distributed to interested parties throughout the region.

One of the major accomplishments of the year was the preparation and printing in color of the first portions of the State type maps. The plan for the procedure involved in making these maps was perfected a year ago, including the type scheme and colors to be used in the procedure of generalization. During the year the type data for the western halves of both States were all generalized, reduced, traced, and submitted to the U.S.G.S. lithographers at Washington, D.C. The Survey's 38 types were consolidated into 25 types for the two States and a separate color or pattern selected for each type. For the northwest quarter of Oregon, colored proof copies have been run and revised, and the final issue should be forthcoming at an early date. For the southwest quarter of Oregon and the northwest quarter of Washington, the eight color plates have been made and proof copies should be available early in 1936. When these are all completed they will be the first complete and detailed forest type maps of two large States ever published.

During the year steady progress was made on the basic inventory computations for both eastern Oregon and eastern Washington, and on December 31, 1935, these were about 40 percent complete for eastern Oregon and 27 percent complete for eastern Washington. Practically all of the data on ownership for both States have been gathered and the basic area calculations made. Late in August, 6 ERA employees were trained to help on Survey office work, and by early winter some 14 to 16 had been trained for computing and map coloring.

Late in the year the publication "Pulpwood Resources of Western Oregon and Western Washington" was printed and distributed. It includes complete and detailed statistics in cubic feet and cords by counties and ownership groups for the pulpwood species, together with tables showing areas of pulpwood types and growth. The demand for this publication necessitated an extra printing of 500 copies after the first thousand had been distributed.

During 1935 the demand for the Forest Survey material increased considerably. Hundreds of copies of the Survey's type maps have been requested. Public agencies, as well as private individuals, use them extensively. Lumber companies, pulp and paper companies, foreign lumber importers, the War Department, the Resettlement Administration, the Regional Forester's office, State tax commissions, State foresters, county officials, chambers of commerce, and others have made extensive use of the Survey's statistical and map data. There has been a steady demand for the Survey's statistics, and every week sees some special request from a public or private agency involving extra computation and recapitulation. The entire time of one computer for the year has been devoted to working up data for these special requests.

The completion of all the basic computations for the Douglas fir region has made possible the use of the information in land use planning and sustained yield projects. Many private and public agencies depend upon the Forest Survey data for basic facts in preparing reports and formulating programs of action. For such important projects as those of the U. S. Engineers and the Northwest Regional Planning Commission, the Survey's findings have been invaluable in giving

reliable information on the present and prospective forest resources.

Forest Land Economics

As a part of the "New Public Domain" project the tax-paying status of 9,882,000 acres of private and county land in eighteen counties of western Oregon and Washington was determined by eight generalized cover types in order to show the land values involved and not involved in long-term tax delinquency, and the bearing this situation has upon forest land ownership. The resultant tables have been mimeographed and analysis is in progress. It is significant that of the 3,556,000 acres involved in long-term tax delinquency, 1,283,000 supported a coniferous stand of saw-timber size which alone indicates the acute distress of forest land owners in this region. Young second-growth conifers from 0 to 20 inches d.b.h. made up an additional 935,000 acres, and recent cut-overs, old cut-overs nonrestocking, and deforested burns accounted for 315,000 acres.

The reports "Statistics on Agricultural Development in Oregon" and "Statistics on Agricultural Development in Washington" were compiled from the years 1880 to 1935, inclusive, and the Oregon report has been published jointly by this Station and the Oregon Agricultural Experiment Station. The results of these studies are being used in estimating the area likely to remain in forest cover and in private ownership. For example, sufficient time has elapsed and land has been available to permit a broad agricultural development in Clallam County, Wash., but such development has not taken place. Settlement began more than 80 years ago. All lands in farms in 1930 occupied

5.2 percent of the total county area, and improved land only 1.9 percent. Approximately 90 percent of the county area is forest land in forest ownership. Failure to sell cut-over and residual timber holdings for farm purposes and inability to suitably capitalize upon them for forest purposes has led to abandoning these lands for unpaid taxes.

Office reports were prepared on the "Influence of Slope Upon the Use of Land for Agricultural Purposes" on 493,628 acres in portions of Clallam and Snohomish Counties in Washington, and Columbia, Lincoln, and Benton Counties in Oregon. The areas studied are mainly forest in character,within which agricultural settlements have been attempted both recently and in the past.

Base, assessed valuation, cover, lay of land, soil, and tax delinquency maps were prepared for special study areas in Columbia, Benton, and Lincoln Counties. Special study consisted mainly of correlations of tax delinquency to cover, soil, and ownership classes. The results are being employed in developing criteria for the desirable ownership and use of land.

Correlation of tax delinquency and size of ownership by generalized cover types was completed for the eighteen selected counties of western Oregon and Washington to determine the influence of size of ownership by cover types on stability of forest land ownership.

In the continuation of the study of progression of foreclosure for unpaid taxes, analyses were made of land foreclosed for unpaid taxes since 1932 and 1933, in Columbia and Coos Counties, by segregating these lands into generalized forest cover types.

A detailed tax study was compiled in an office report that gave comparisons between valuation for tax purposes and valuation based upon annual forest producing capacity of real estate acreage in forest ownership within school district 18 in Columbia County, Oreg.

Another study revealed that the 1934 tax on timber and forest land amounted to $1.47 in Oregon and 80 cents in Washington per thousand board feet cut. Extremes in variation of assessed valuation and taxes were found in both States. This is resulting in the premature liquidation of forest capital and aggravating the problems of ownership.

Estimated assessed valuation and estimated actual valuation of land in county ownership was compiled in table form for the eighteen selected counties of Oregon and Washington.

The situations revealed by these and other studies conducted by this section are receiving broad consideration by public and private agencies, including state and county planning commissions, forest protectionists, forest land owners, public administrators, and legislators. The demand for the results of the Station studies has placed members of this section in close and intimate touch with the general land planning movement of the region, Mr. Wilson being chairman of the Land Resources Division of the Pacific Northwest Regional Planning Commission.

Logging Economics

"Selective Timber Management in the Douglas Fir Region" is the title of a report by Kirkland of the Washington office and Brandstrom of this Station, which was completed last summer and which is now in the process of publication by the Charles Lathrop Pack Forestry Foundation. It is the second report to be published as a result of selective logging studies conducted at this Station since 1931. The first one "Analysis of Logging Costs and Operating Methods in the Douglas Fir Region", by Brandstrom, was published by the Pack Foundation in 1933. Many of the findings of the first report are developed and applied to management problems discussed in the present report.

The new report is a searching, thought-provoking analysis of the economic aspects and the feasibility of applying intensive methods of selective timber management under conditions heretofore thought prohibitive of any methods except traditional broad-scale clear cutting. It delves deeply into broad principles, as well as illustrative details of procedure, as becomes necessary in demonstrating the application of selection in this region with its many complicated operating problems. The principles and procedures developed and advocated, if they can be worked out on a large scale in actual practice, may have far-reaching effects on both public and private timber management. New and revolutionary in its approach, full of suggestions for radical changes in operation and management, and with several important controversial points in the foreground, this report will, if nothing else, have a very stimulating effect on our forestry thinking in this region.

This section cooperated with representatives of the Regional Office in connection with mapping and appraisal technic and in laying out experimental selective logging operations on national forests. Co-operation was given also to private logging operators seeking advice on various logging problems, particularly in connection with motor truck and tractor logging.

Selective Timber Management in the Ponderosa Pine Region was the subject upon which the work of this section was focussed during the last half of the year. A crew of five spent about four months in the field, mainly on time and cost studies of yarding, loading, felling and bucking, and motor truck and railroad transportation in eight different operations in eastern Oregon. These studies are designed to determine the effect of log and tree diameter on logging cost and also to compare the relative efficiency of various logging methods. The same field crew also worked in cooperation with the Section of Forest Products on a mill scale study designed among other things to determine the effect of log and tree diameter and log grade on recovery values; and with the Section of Silviculture on a local growth study designed to correlate tree diameter and tree class with growth rates. With these basic studies to draw from, the study of the economics of selective timber management can proceed.

In the pine region selective logging is no newcomer, as is the case in the Douglas fir region. Operating problems generally are simple and the operators are eager to cooperate and anxious to learn in what way these studies may help them in the solution of their problems.

While practically all pine operators are now practicing some form of selection, and while selective management is an established policy on all national forest timber sales, there is nevertheless much to be learned about what form and degree of selection should be practiced on private as well as on public timber holdings. The possibilities for changing to light selection and short cutting cycles appear particularly bright, and hold the promise of leading to better forestry as well as to greater immediate returns from cutting. It is toward this end that the present studies of logging costs, operating methods, and the basic economic aspects of ponderosa pine management may prove most fruitful.

Cooperation was extended to the Western Pine Association and the forestry faculty of the University of Washington in connection with a selective logging and milling study conducted by the agencies in a ponderosa pine operation in eastern Washington. This section supplied field study forms and furnished detailed advice on the technic of conducting both the field and office analysis phase of the study.

Forest Products Investigations

Ponderosa Pine Mill Production Study. After a lapse of seven years mill production analyses in ponderosa pine mills were resumed the past summer with a comprehensive study at the mill of the Edward Hines Lumber Company. This was a cooperative project with the company, the Regional Forester, and the Section of Forest Economics, conducted as an integral part of the problem of the economics of the management of ponderosa pine forests. Analysis was made of 1,300 logs yielding a third

of a million feet of lumber. Six log grades were established, the characteristics of which were based on external appearance, so that the grades are applicable to both logs and standing timber. Analysis indicated that the grades established gave well defined value classes, except that the two middle grades were almost identical in value. Under the selling prices and costs obtaining in the mill at the time of the study there was a margin with which to defray previously incurred costs, ranging from approximately $5 in 12-inch low-grade logs to $19 in 36-inch high-grade logs. It is evident that the margin for small low-grade logs is insufficient to defray logging costs and pay stumpage, to say nothing of yielding a profit. The data developed in this study are basic to the determination of tree values which, in conjunction with logging cost data and silvicultural considerations, should control the most permanently desirable method of cutting.

Douglas Fir Mill Production Studies. The small mill has advanced in importance in the Pacific Northwest, and undoubtedly will become more firmly entrenched. But there are many problems attendant upon any marked shift from large to small operations. The industry will solve many of them; others that concern fundamental principles logically come within the province of research. Before investigating such fundamental problems as the relative efficiency of mills of different capacities and the effect of mill location on production costs, utilization of by-products, and the stabilization of communities, it was found necessary to establish a series of grades for the second-growth and small old-growth logs usually handled in the small mill. Best results

have been obtained with a series of six grades based on relative clearness and upon knot size and type. Preliminary analyses of approximately 1,200 logs studied in three mills cutting from 20-25 M per day indicate that these grades are relatively easy to apply in the field. The descriptions as now written, however, permit too great a range in lumber grade and value recoveries. As opportunity permits, these variations will be traced and the log grade descriptions modified accordingly.

Statistical Studies. The annual production, price, and distribution statistical work has occupied a large part of one man's time. The lumber, lath, shingle, and log production census for 1934, in cooperation with the Bureau of the Census, was completed in June. The 5,444,000,000-foot lumber cut in Oregon and Washington exceeded that of 1933 by 15 percent. Production data have been reworked to furnish cutting depletion information for the Forest Survey. The data in various forms have been requested by state and government agencies, trade organization, planning councils, chambers of commerce, federal reserve banks, and individuals. Statistics on log and shingle prices and on the prices of various oils, barks, and balsams were summarized for distribution. Export statistics on logs, lumber, and wood products were compiled.

Minor Species Studies. The series of publications on properties and uses of minor tree species of the region was continued through trade journal publication of "Northern Black Cottonwood - Its Properties and Uses". Additional data are being accumulated on other species, especially Oregon ash.

Miscellaneous Studies. Measurements on 250 cords of pulpwood as ricked by the cutters gave an average solid contents of 86 cubic feet per cord. This figure, together with data on the degree of utilization in trees of different sizes, appeared as a trade journal article, and has been used as basic in computing expected growth and yield of pulpwood species by the Forest Survey.

The Station has been active in supplying statistics for and making analyses of pulpwood production and consumption, availability of mill and logging waste, and other factors basic to development of the pulp and paper industry in the Pacific Northwest. Most of this has been done in cooperation with the Regional Forester for the Regional Planning Board and the U. S. Engineers.

At the request of the committee in charge of developing standard testing methods for the Technical Association of the Pulp and Paper Industry, Dr. Lodewick, and Professor Harrar of the University of Washington, have prepared a suggested standard for the identification of pulp woods and pulpwood fibers.

A digest of the findings of the investigation on deterioration in fire-killed Douglas fir, carried on in 1934 in cooperation with the Bureau of Entomology and Bureau of Plant Industry, was published in a trade journal.

At the request of the Regional Forester, the Station has assumed responsibility for periodic examination of treated telephone poles on the national forests in Region Six. In the past four years emphasis has been placed on the use of Anaconda paste in localities

where cedar is not readily available. Approximately half of the lines so treated were examined during the summer. The remainder will be visited during the coming field season, after which lines will be selected for intensive periodic examination. Of the paste-treated poles examined, many of which had been in place for three years, none showed evidences of decay or insect attack at the ground line. Untreated poles under similar conditions showed either discoloration or decay, indicating that the preservative had been effective.

The management of farm woodlands, of which there are 2,800,000 acres in the Douglas fir region, is being approached from the marketing standpoint, under the assumption that the value of forestry practices can be more readily shown through this approach. The first article in the series, showing the value of these woodlands to the owner and the community, has been prepared. This will be followed by others explaining the principles of management and marketing, and by field work which will provide background for intelligent advice on market outlets, cost of production, etc.

Publications and Dissemination of Results

The results of the Station's findings are to a considerable extent disseminated through informal news releases, personal contacts, public addresses, and correspondence. Members of the technical staff have made some 28 formal talks during the year at technical and general gatherings and in radio broadcasts. A number of major manuscripts have been prepared that are now awaiting publication as government bulletins or otherwise. A list of the formal material printed during the year in periodicals or otherwise and a list of the technical material distributed in mimeograph or photostated form follow. Items marked with an asterisk are available for free distribution.

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	Spruce leaf oil prices	"
	Oregon fir balsam prices	"
	Cedar leaf oil prices	"
	Cascara bark prices	"
	Canada balsam prices	"

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Appendix

List of Current Projects, Calendar Year 1935, Pacific Northwest Forest Experiment Station, Exclusive of the Projects of Cooperating Local Agencies - the Forest Insect Field Station and the Office of Forest Pathology.

B-1	Phenology of forest trees and associated vegetation.
Fs	Genetic traits of various strains of Douglas fir and ponderosa pine seed.
Fn	Nursery practice for Pacific Northwest tree species.
Fp	Technic of out-planting, - including species, sites, and methods studies, and direct seeding.
Fp-Exotics	Adaptability of exotic species to the Pacific Northwest, including maintaining Wind River Arboretum.
M-1	Silviculture of Douglas fir, especially through partial cutting, as well as basic silvical study of the species.
M-1 Slash Disposal	The disposal of slashings in the Douglas fir and spruce-hemlock types.
M-2	Silviculture of ponderosa pine, including principles of good management of this type.
M-3	Silviculture of the spruce-hemlock type, including basic silvics of these species.
Mt-1	Stand improvement in immature Douglas fir forests.
Mt-2	Stand improvement in ponderosa pine forests.
ME-1	Mensuration of Douglas fir type, including studies of growth, yield, volume, and form.
ME-2	Mensuration of ponderosa pine type, particularly yield of even-aged stands and regional growth of virgin stands.
ME-3	Mensuration of spruce-hemlock, particularly growth of even-aged stands in the fog belt and volume studies of spruce.
Pf-1	Technics of fire prevention, detection and suppression, particularly fire-danger rating and visibility studies.
Pf-2	Factors which influence fire spread and behavior.

Pf-3	Fire damage, including effect of fire on stands of various kinds.
RP L-260	Ponderosa pine and Douglas fir sawmilling studies.
RP-Woods & Mill Utilization	Investigations of methods for reducing woods and mill waste and bettering utilization practice.
RP-Species Studies	Utilization of minor species, especially the hardwoods of the Pacific Northwest.
RP-Special Studies	Miscellaneous studies and service tests of the identification, utilization, and durability of local woods.
RE Statistics	Annual lumber, lath, shingle and log census in cooperation with the U. S. Bureau of the Census; also statistical studies of production, distribution, and prices of forest products.
RE	The Forest Survey of the Douglas fir region.
RE	The Forest Survey of eastern Oregon and Washington.
RE	Tax delinquency and abandonment of forest lands.
RE	Financial aspects of forest management and exploitation in the ponderosa pine region.
RE	Economic aspects of selective logging in Douglas fir region.